Antibiotic Prescribing Patterns and Their Rational Use in Primary Health Centers: A Retrospective Analysis

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Received: 10th Mar, 2026 | Revised: 25th Mar, 2026 | Accepted: 20th Apr, 2026 | Published: 05th May, 2026

ABSTRACT

Background

Antimicrobial resistance is a major public health concern caused largely by irrational antibiotic use, especially in primary healthcare. Monitoring prescribing patterns with WHO/INRUD indicators helps assess rational drug use.

Objectives

To evaluate antibiotic prescribing patterns, assess rational use of antibiotics, and identify factors influencing antibiotic prescribing in selected primary health facilities.

Methods

This retrospective observational study reviewed 147 outpatient prescriptions from primary health clinics in Meerut, Uttar Pradesh, over one year. Data on demographics, diagnoses, drug use, WHO/INRUD indicators, and antibiotic prescribing were analyzed using descriptive statistics and logistic regression.

Results

Most patients were females (60.9%) and aged 25–44 years (23.9%). Malaria was the most common diagnosis (61.8%), followed by upper and lower respiratory tract infections. Antibiotics were prescribed in 59.9% of encounters, and the average number of drugs per prescription was 4.0, indicating polypharmacy. Generic prescribing was 79.2%, Essential Medicines List use was 88.1%, injections were prescribed in 22.9% of cases, and possible drug interactions were found in 4.9%. Younger age, greater number of drugs, lack of antimalarial therapy, and certain diagnoses significantly predicted antibiotic use.

Conclusion

Antibiotic overuse and polypharmacy were common. Although injection use was acceptable, generic prescribing and adherence to WHO standards were suboptimal. Regular prescription audits, adherence to treatment guidelines, and antimicrobial stewardship programs are needed to improve rational antibiotic use.

Keywords: Antibiotic, rational drug, primary health care, prescribing.

How to cite this article: Kumar S, Singh N. Antibiotic Prescribing Patterns and Their Rational Use in Primary Health Centers: A Retrospective Analysis. Int J Drug Deliv Technol. 2026;16(57s): 1-11. DOI: 10.25258/ijddt.16.57s.1

Source of support: Nil.

Conflict of interest: None.

1. Introduction

For almost 50 years, antimicrobial medications have been utilised extensively in human medicine, either as treatments or as preventative measures, and they have greatly improved human health. Unfortunately, drug-resistant microorganisms have emerged as a result of extensive use, abuse, or improper prescribing [1]. A worldwide public health concern is antibiotic resistance. Antibiotic use and the degree of antibiotic resistance are positively correlated, according to studies [2]. The frequency of diseases caused by bacteria that are resistant to antibiotics is increasing and surpassing the rate at which new types of antibiotics are found and produced [3]. Public health initiatives to control infectious diseases through particular disease control programs that depend on the use of antimicrobials as a method for control and prevention are also hampered by antimicrobial resistance. Antimicrobial resistance can be stopped by using them prudently.

Drug-resistant bacterial infections have raised hospital stays and treatment costs in addition to morbidity and mortality. Because patients with infections caused by drug-resistant bacteria require a different level of care than those with infections caused by drug-sensitive bacteria, when infections become resistant to first-line antibiotics, more costly second-line therapies must be used. This results in a longer duration of illness and treatment in hospitals, which frequently increases health care costs as well as the financial burden on families and societies [4,5]. To effectively control antibiotic resistance, research and monitoring must be expanded outside of affluent nations since the human economic cost of trying to catch up on antibiotic resistance is too high [6].According to current estimates, the economic impact of antimicrobial resistance in the UK ranges from less than 5 GB£ to over 20,000 GB£ in increased hospital expenses per patient for each episode of sickness [7].

According to research conducted in Thailand [8], hospitalization costs for patients with community-onset extended spectrum beta lactamase-producing E. coli infections were US$528, whereas those with community-onset non-extended spectrum beta lactamase-producing E. coli infections were US$108. One of the biggest successes of contemporary medicine is the effectiveness of antimicrobials against pathogenic bacteria. However, the development and spread of antimicrobial resistance (AMR) has made many antimicrobials less effective after more than 70 years of extensive usage [9]. There is broad agreement that the overprescription of antibiotics is the primary cause of AMR development [10].

It is vital to restrict the use of antibiotics to what is required and suitable since more antibiotics are used, especially when they are abused, the more selection pressure is put on bacteria to acquire resistance genes [11]. The majority of bacteria that infect humans and animals have evolved a significant degree of resistance to widely used first-line antibiotics, according to research done in Ethiopia [12,13]. Reasonable antibiotic prescription is the best way to fight antibiotic resistance [14]. AMR stands for antibiotic resistance (antibacterials), and antibiotics are those antimicrobial medicines used to prevent and cure bacterial infections.

WHO advises regular monitoring of antibiotic usage in order to avoid the development of antibiotic resistance and its consequences for human health. at order to look into drug usage at medical institutions, the WHO and the International Network of Rational usage of Drugs (INRUD) developed a list of specific indicators in 1993. The average number of medications prescribed per consultation (optimal value 1.6–1.8), the percentage of drugs prescribed by generic name (optimal value 100%), the percentage of encounters where an antibiotic was prescribed (optimal value 20.0%–26.8%), the percentage of encounters where injections were prescribed (optimal value 20.0%–26.8%), and the percentage of medications prescribed from the Essential Drugs List (optimal value 100%) are examples of core prescribing indicators developed by WHO/INRUD [15,16]. Even though there are guidelines for prescription practices at health care facilities (HCF), a number of studies have shown that common antibiotics are significantly overused in underdeveloped nations, especially in primary healthcare facilities [17].

Although antibiotics have significantly improved the treatment of bacterial illnesses, their overuse and use have led to the development of antimicrobial resistance (AMR), a serious public health issue. The danger of resistant infections, extended sickness, increased treatment costs, and increased strain on healthcare systems are all increased when antibiotics are used inappropriately. Since prescription practices at this level have a direct impact on community health, primary health clinics are crucial locations for assessing antibiotic usage. To guarantee proper usage and prevent the emergence of resistance, rational antibiotic prescribing—guided by conventional treatment regimens and WHO/INRUD prescribing indicators—is crucial. In order to evaluate antibiotic prescription trends and their sensible usage in primary health clinics, a retrospective analysis was carried out.

2. Methodology

2.1 Study design

In order to evaluate antibiotic prescribing trends and their sensible usage in primary health clinics, this study was created as a retrospective, record-based observational study of outpatient prescriptions. Using WHO/INRUD prescription indicators for rational medication use evaluation, the methodological framework was modified from a retrospective audit approach.

2.2 Study area

The study was carried out in a few basic health facilities in the Indian state of Uttar Pradesh's Meerut area. In order to evaluate antibiotic prescribing behaviours at the primary care level, these centers were selected as representative first-contact healthcare institutions that offer outpatient treatment to the community.

2.3 Study duration

Over the course of one year, the study was conducted. Data from outpatient records and medications written throughout the research period were gathered retrospectively.

2.4 Sample size

The study comprised 147 patient records and medications for analysis.

2.5 Inclusion criteria

- During the one-year research period, outpatient prescriptions and records from the chosen primary health clinics were collected.
- Patient records for both sexes and all age groups.
- Documents that include pertinent characteristics including age, gender, illness, and prescribed medications, including information about antibiotics when appropriate. This method is in line with the reference study's extraction of medication, diagnostic, and demographic information from outpatient records.

2.6 Exclusion criteria

- Prescriptions or records that are unclear or incomplete.
- Records that don't contain critical variables needed for analysis, including a diagnosis or specifics on a medication.
- Records pertaining to emergencies, inpatients, or unrelated outpatient visits.
- If duplicate or repeated prescription entries are found during record screening.

2.7 Data collection

An organized and standardized data collecting form was used to gather information from prescription records and registries in the past. The following variables may be included in the proforma for the current study: Age, gender, diagnosis, number of diagnoses per encounter, kind of medication prescribed, antibiotic prescription (yes/no), quantity of medications prescribed, prescriptions for generics and injections, medications from the Essential Medicines List (EML), and any drug interactions.

2.8 Study procedure

Outpatient prescription data for the one-year research period were obtained and evaluated in accordance with the predetermined inclusion and exclusion criteria after receiving consent from the appropriate authorities and chosen primary health clinics. An organized and standardized proforma was used to gather the necessary data, and the qualifying records were examined in retrospect. Patient demographics, clinical diagnoses, and specifics of prescription medications—with a focus on antibiotic usage and other prescribing indicators—were all taken from the data. Each prescription was given a unique number for analytical reasons rather than patient names or other identification in order to preserve anonymity. The tool was pretested to make sure it was appropriate before the primary data collection, and data quality was further enhanced by frequent oversight and cross-checking of specific entries with the original source documents to guarantee correctness and consistency. This approach was modified from previously released retrospective research assessing the prescription habits of antibiotics in primary care settings.

2.9 Risk factor analysis

Antibiotic prescription can be used as the outcome variable (antibiotic prescribed: yes/no) in risk factor analysis to find variables related to antibiotic prescribing. To find independent predictors of antibiotic prescription while controlling confounding factors, multivariate logistic regression should be performed after bivariate analysis to look at crude relationships.

2.10 Statistical analysis

Data was verified for accuracy and consistency before being placed into a spreadsheet or statistical program. percentages and frequencies for categorical factors including gender, age group, diagnosis, and kind of medication. For continuous data like the average number of medications and diagnoses each contact, the mean and standard deviation are used. When comparing categorical variables, the chi-square test or Fisher's exact test may be utilized. It is possible to use binary logistic regression to identify variables linked to the prescription of antibiotics.

3. Result

Table 1 displays the characteristics of the patients who were part in the trial. 147 prescription records in all were examined. The age group of 25–44 years old accounted for the biggest percentage of patients (23.9%), followed by 5–14 years old (18.3%) and younger than 5 years old (18.1%). With 60.9% of the study population being female, female patients predominated. The majority of patients (90.3%) covered the records with insurance information. The most common diagnosis was malaria (61.8%), which was followed by upper respiratory infection (17.3%) and lower respiratory infection (11.2%). Anaemia, gastroenteritis, enteric fever, intestinal worms, musculoskeletal illnesses, dermatological issues, and arthritic disorders were among the additional diagnoses. Analgesics were the most often given medications (27.1%), followed by antibiotics (19.1%) and antimalarials (18.1%). Thirteen percent of recommended medications were vitamins and supplements. A significant percentage of prescriptions included more than one medication, with 34.9% of prescriptions including five or more medications.

Table 1. Patient characterstics in sampled records

Variable	Category	Percentage (%)	Frequency (n)
Age Group (years)	<5	18.1	27
	5–14	18.3	27
	15–24	16	24
	25–44	23.9	35
	45–64	15.8	23
	≥65	8.1	12
Gender	Male	39.1	57
	Female	60.9	90

Health Insurance Status	Insured	90.3	133
	Non-insured	9.1	13
Diagnosis	Malaria	61.8	82
	Upper respiratory infection	17.3	23
	Lower respiratory infection	11.2	15
	Musculoskeletal disorders	8.4	11
	Dermatological diseases	8	11
	Intestinal worms	6.2	8
	Arthritic disorders	6	8
	Anaemia	5.7	8
	Gastroenteritis	5.6	7
	Enteric fever	4.1	5
	Others	29.3	39
Category of Medicines Prescribed	Analgesics	27.1	159
	Antibiotics	19.1	112
	Antimalarials	18.1	106
	Vitamins & supplements	13	76
	Cough preparations	4.7	28
	Iron-based haematinics	3.2	19
	Others	14.9	88

Medicines per Prescription	≤2 medicines	12.2	18
	3 medicines	29.4	43
	4 medicines	23.5	35
	≥5 medicines	34.9	51

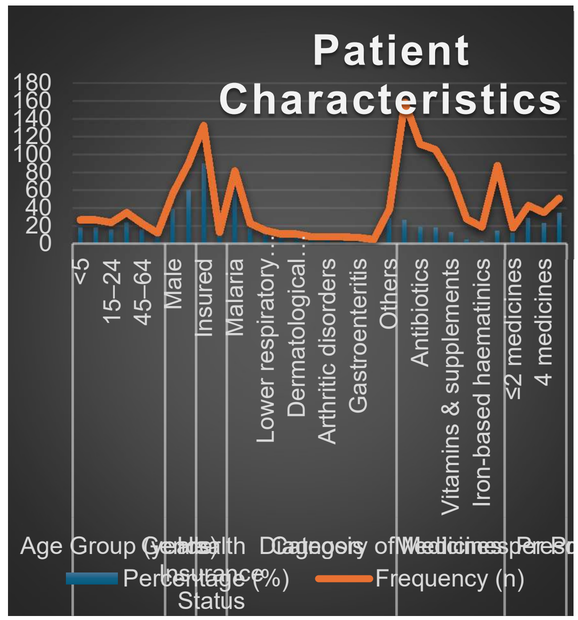

Figure 1. Patient characterstics

The average number of medications prescribed for each contact was 4.0, according to the prescribing indicators seen in this study, suggesting a comparatively high number of medications provided by every patient visit. Antibiotics were used frequently in the study context, as seen by 59.9% of prescriptions that contained at least one antibiotic. 88.1% of the medications were prescribed from the Essential Medicines List (EML), whilst 79.2% of the medications were prescribed under generic names. Furthermore, as **table 2** illustrates, 4.9% of prescriptions included possible medication interactions, and 22.9% of contacts required an injection. many diagnoses were documented in many patient interactions, as evidenced by the average number of diagnoses per contact of 1.69. When combined, these results give an overview of the rationality of medication usage in the research population and represent the prescribing pattern in the chosen primary health facilities.

Table 2. Prescribing indicators

Indicator	Value
Average number of medicines per encounter	4
% prescriptions with antibiotics	59.90%
% medicines prescribed by generic name	79.20%
% encounters with injection	22.90%
% medicines from EML	88.10%
% prescriptions with drug interactions	4.90%
Avg. diagnoses per encounter	1.69

The factors impacting the practice of prescription antibiotics are displayed in **Table 3**. Antibiotic prescription was significantly correlated with the type of healthcare facility, patient age, gender, number of diagnoses stated, number of medications prescribed, malaria treatment, diagnosis of URTIs, diagnosis of dermatological diseases, and diagnosis of musculoskeletal disorders in the bivariate analysis. Health center/clinic attendance (OR = 2.05; 95% CI: 1.42–2.95; p < 0.001), younger age (OR = 0.97; 95% CI: 0.97–0.98; p < 0.001), more medications prescribed (OR = 1.85; 95% CI: 1.63–2.10; p < 0.001), lack of antimalarial treatment (OR = 5.05; 95% CI: 2.08–12.25; p < 0.001), malaria with other conditions (OR = 4.72; 95% CI: 1.86–11.99; p = 0.001). After correction, gender, health insurance status, the number of illnesses reported, and the diagnosis of dermatological diseases were not significant.

Table3.Factors influencing antibiotic prescribing practice

0	N	OR (Bivariate)	95% CI	P-value	n	OR (Multivariate)	95% CI	P-value
Type of Health Facility								
Hospital (Ref)	37	1	–	–	36	1	–	–
Health centre/clinic	110	1.89	1.50–2.37	< 0.001	96	2.05	1.42–2.95	< 0.001
Patient age (years)	147	0.98	0.97–0.98	< 0.001	132	0.97	0.97–0.98	< 0.001
Gender								
Female (Ref)	90	1	–	–	81	1	–	–
Male	57	1.29	1.05–1.59	0.015	51	1.17	0.88–1.56	0.279
Health Insurance Status								
Insured (Ref)	133	1	–	–	119	1	–	–
Non-insured	14	1.08	0.76–1.	0.682	13	0.78	0.49–1.	0.279

			53				23	
No. of diagnoses stated								
1 diagnosis (Ref)	60	1	–	–	60	1	–	–
≥2 diagnoses	73	3.82	3.06–4.76	< 0.001	72	1.45	0.85–2.47	0.172
No. of medicines prescribed	147	1.83	1.68–2.01	< 0.001	132	1.85	1.63–2.10	< 0.001
Malaria treatment prescribed								
Yes (Ref)	91	1	–	–	80	1	–	–
No	56	1.47	1.19–1.82	< 0.001	52	5.05	2.08–12.25	< 0.001
Malaria diagnosis								
Malaria only (Ref)	27	1	–	–	27	1	–	–
No malaria	65	10.5	7.37–14.82	< 0.001	51	4.72	1.86–11.99	0.001
Malaria + other conditions	55	13.73	9.58–19.67	< 0.001	54	4.95	2.62–9.37	< 0.001
URTI diagnosis								
No URTI (Ref)	124	1	–	–	109	1	–	–
URTI only	4	16.4	3.95–68.08	< 0.001	4	7.27	1.66–31.82	0.008
URTI + other conditions	19	4.51	3.05–6.67	< 0.001	19	1.86	1.18–2.93	0.008
Dermatological disease diagnosis								
No dermatological disease (Ref)	136	1	–	–	121	1	–	–
Dermatological disease	3	3.05	1.14–8.13	0.026	3	1.95	0.64–5.97	0.241

Dermatological + other	8	4.3	2.37–7.81	< 0.001	8	1.56	0.80–3.06	0.197
Musculoskeletal disorder diagnosis								
MSK only (Ref)	6	1	–	–	6	1	–	–
No MSK disorder	136	18.9	7.51–47.37	< 0.001	121	20.4	7.57–55.00	< 0.001
MSK + other conditions	5	8	2.80–22.84	< 0.001	5	6.89	2.14–22.22	0.001

4. Discussion

Using WHO/INRUD prescription indicators, the current study assessed antibiotic prescribing practices and their sensible use in primary health facilities. The results point to a significant level of inappropriate prescribing, especially in relation to antibiotic usage and polypharmacy. The WHO/INRUD optimum range of 1.6–1.8 medications per contact is significantly lower than the average number of medications per encounter in the current research, which was 4.0. Similarly, the percentage of antibiotic-containing prescriptions was 59.9%, which is much higher than the WHO-recommended range of 20.0%–26.8% and indicates overuse of antibiotics. Generic prescriptions (79.2%) and prescriptions from the Essential Medicines List (88.1%) remained below the ideal norm of 100%, indicating partial adherence to rational prescribing principles, even though the percentage of encounters involving injections (22.9%) fell within the WHO guideline range. These results corroborate past findings that irrational medication usage is still prevalent in basic healthcare settings, particularly in poor nations.

The average number of medications per prescription was 2.0, falling within the WHO's suggested limit [18]. 56.0% of the analysis's prescriptions contained one or more antibiotics, with an average of 0.61 antibiotics per prescription. This proportion of antibiotic-containing prescriptions is significantly higher than the WHO's suggested threshold of 30%. This number is similar to the national averages found in the national pharmaceutical sector evaluations conducted in 2003 [19] and 2010 [20], which stated that the percentage of antibiotics was 58% and 60%, respectively. The results, however, are much lower than the national value (62.3%) for health centers in the same research and the figure (87.7%) recorded for Addis Ababa City Administration in the 2003 national pharmaceutical sector evaluation. The current results show that antibiotic use in the city is consistently high.

Another significant finding in this study was polypharmacy. The average number of diagnoses per contact was 1.69, and more than one-third of prescriptions (34.9%) contained five or more medications, suggesting that multiple diagnoses and multiple drug usage were prevalent. The most commonly given medications were analgesics (27.1%), antibiotics (19.1%), and antimalarials (18.1%). The results of Ahiabu et al. [21], who found an average of 4.01 medications per interaction and comparably high antibiotic usage in Ghanaian basic healthcare facilities, are similar to this pattern. Additionally, their analysis showed that the likelihood of prescribing antibiotics increased considerably with the number of medications per prescription, indicating that polypharmacy and antibiotic misuse may coexist as part of illogical prescribing practice. Furthermore, Holloway et al. found that the use of medications in emerging and transitional nations has not much improved over time, with antibiotic prescriptions in primary care and the number of medications per contact continuing to rise.

In this study, 59.9% of prescriptions contained at least one antibiotic, and antibiotics accounted for 19.1% of total medicines prescribed, exceeding the reference value of <30% recommended by the WHO [22]. The antibiotic use rate in this study is similar to that reported by the WHO (47%) [23]. However, it is lower when compared to estimates provided for the Eastern Mediterranean region (53.2%) but higher than that of the Americas (39.3%) and Europe.

59.9% of prescriptions in the current study contained at least one antibiotic, indicating a high rate of antibiotic prescribing in a subset of primary health facilities. Over one-third of prescriptions (34.9%) contained five or more medications, indicating a significant prevalence of polypharmacy. The average number of medications per contact was 4.0. The most common diagnosis was malaria, which was followed by upper and lower respiratory diseases. 79.2% and 88.1% of medications were prescribed generic and from the Essential Medicines List, respectively; 4.9% of prescriptions had possible drug interactions and 22.9% of contacts involved injections. Antibiotic prescribing was found to be significantly predicted by health center/clinic attendance, younger age, more medications prescribed, lack of antimalarial treatment, malaria-related diagnostic categories, URTI diagnosis, and musculoskeletal disorder categories, according to multivariate analysis. These results highlight the need for focused measures to encourage more sensible antibiotic use in primary health clinics and show that both patient- and prescription-related factors affected antibiotic use in the study context.

Conclusion

This retrospective analysis discovered that antibiotic prescribing was high in selected primary health centres, with 59.9% of prescriptions containing at least one antibiotic, while the average number of medicines per encounter was 4.0 and 34.9% of prescriptions contained five or more medicines, indicating polypharmacy. The most frequent diagnosis was malaria, which was followed by upper and lower respiratory tract infections, which seemed to have a significant impact on the usage of antibiotics. While injectable use (22.9%) was within the acceptable range, the percentage of medications given by generic name (79.2%) and from the Essential Medicines List (88.1%) fell short of the ideal WHO criterion. Antibiotic prescribing was also significantly predicted by health center/clinic attendance, younger age, more medications dispensed, lack of antimalarial treatment, malaria-related illnesses, URTI diagnoses, and musculoskeletal problem categories, according to multivariate analysis. In order to reduce needless antibiotic exposure and aid in the fight against antimicrobial resistance, the results emphasise the necessity of strengthening rational antibiotic use in primary health centers through routine prescription audits, improved adherence to standard treatment guidelines, encouragement of generic prescribing, and antimicrobial stewardship measures.

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